



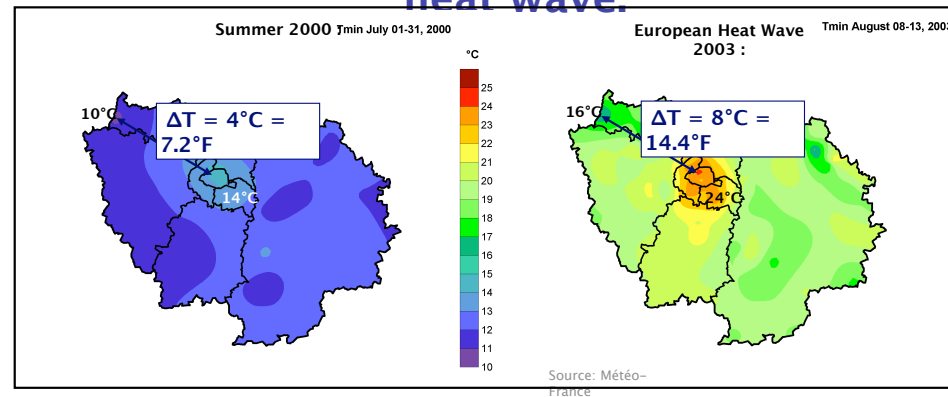
The influence of air-conditioning on street temperatures in the city of Paris

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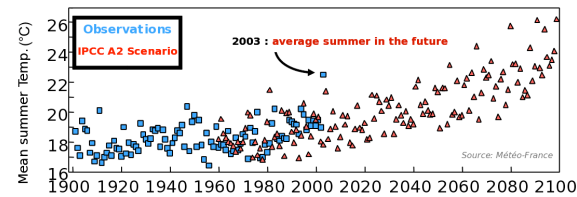
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Urban heat island intensity increases during a heat wave.



A standard summer in France by the 2060s will look like the summer we experienced in 2003.



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Night time heat island

Air Conditioning and Urban Climate

Facts and figures

- The use of AC systems, while cooling the inside of buildings, releases waste heat in the atmosphere.
- In Tokyo, a study showed a 1–2°C increase in air temperature due to AC usage during weekdays (Ohashi et al. 2007)
- **Energy consumption due to AC in August 2003 represented 10% of total electrical consumption.**
- France is expecting a **180% increase in energy consumption due to AC by 2020**



What is the effect of cooling systems on the climate of greater Paris... now and tomorrow ? Rather during the day or at night?

Do some types of AC systems affect more the urban climate than others?

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Findings

- The air-conditioning used to meet the cooling needs of Paris buildings during a heat wave increases street air temperatures.
- The increase in street temperatures due to air-conditioning is greater at night time than day time, which exacerbates night time thermal stress.
- Different AC systems have different impacts on outdoor temperatures. The proliferation of dry systems shows the greatest increase in Urban Heat Island.
- Temperature increase due to AC will lead to an increasing air cooling demand.

Vicious Circle

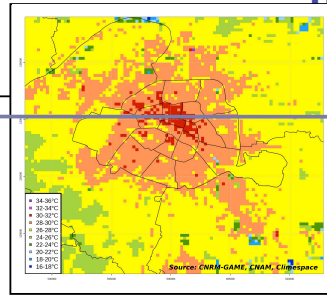
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(and consequently energy consumption), while at the same time lowering the efficiency of air-conditioning units.

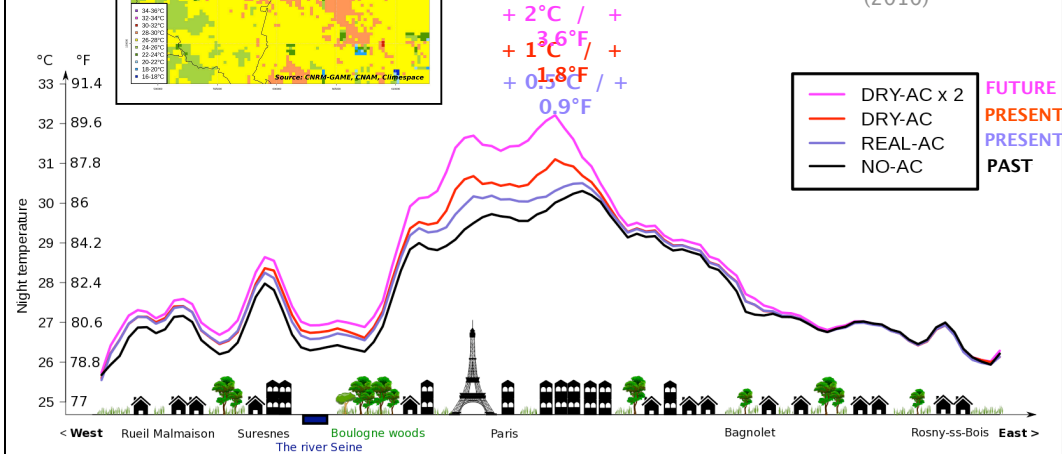
Feed-back on air cooling demand:

Air-Conditioning Increases Paris night temperatures



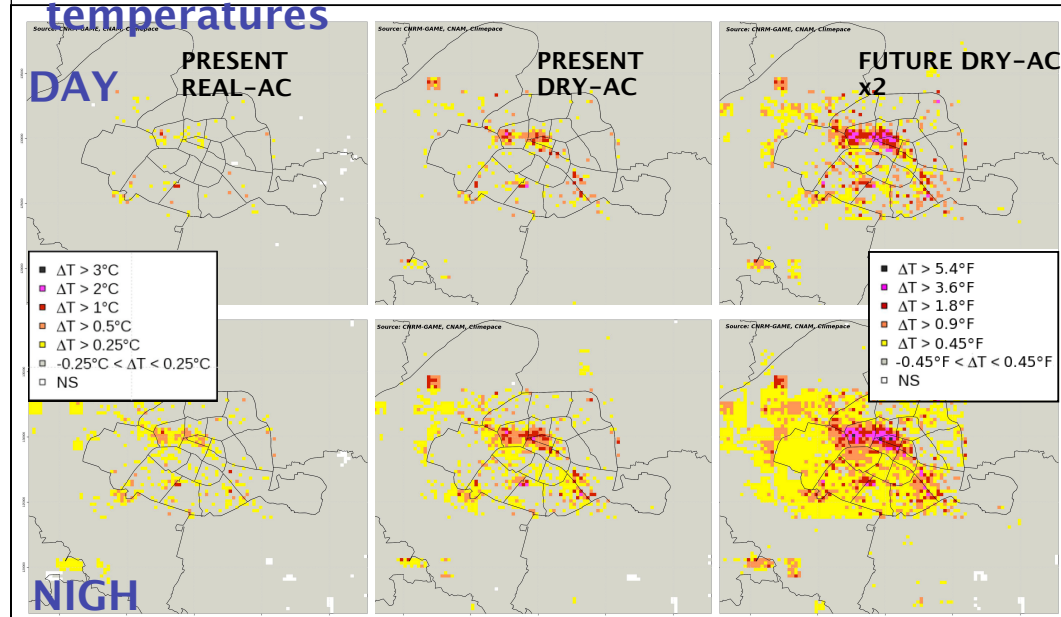
DRY-AC x	If AC systems release DOUBLE previous DRY
DRY-AC	If all AC systems release DRY waste heat
REAL-AC	Current AC systems co-existing in the city
NO-AC	Baseline scenario, no air-conditioning

Source: de Munck et al. (2010)



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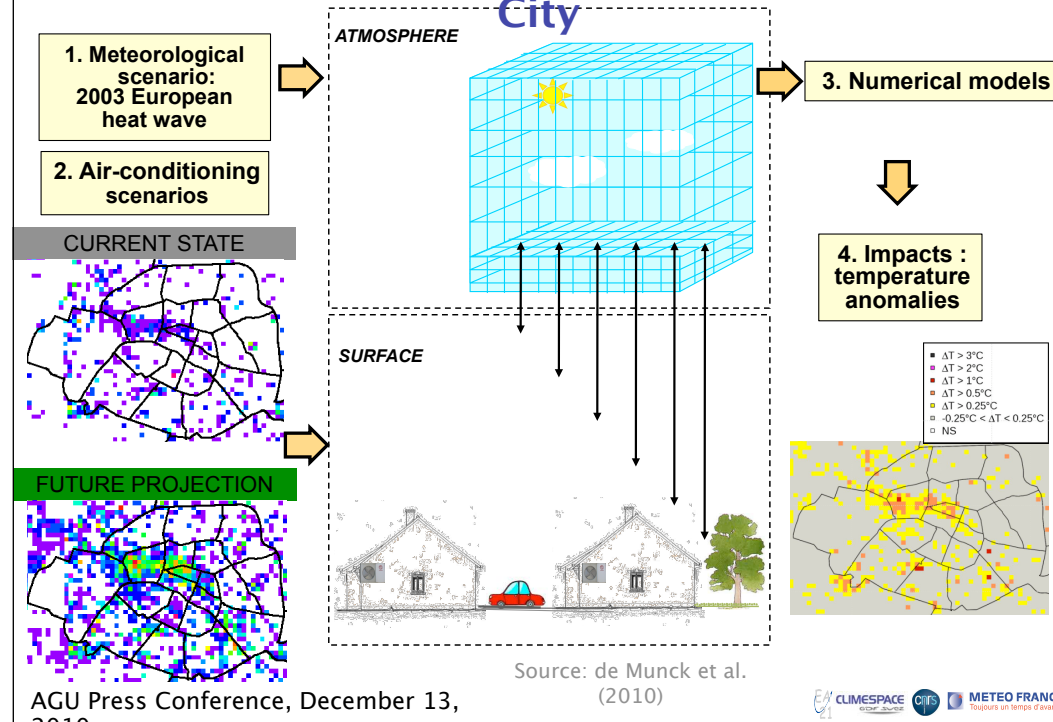
- Increase in street temperatures is greater at night
- Dry systems show the greatest increase in temperatures



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Source: de Munck et al. (2010)

Method : Integrated Modeling of the City



Air-Conditioning

Source: de Munck et al.
(2018)

Scenari	Description	
NO-AC	Baseline scenario, no air-conditioning	
PRESENT REAL-AC	<p>Current types of air-conditioning systems co-existing in the city:</p> <ul style="list-style-type: none"> • units discharging DRY waste heat to air • units discharging WET waste heat to water • units discharging waste heat to the SEA <p>5.16 GW</p>	
PRESENT DRY-AC	<p>What if all AC systems were converted to units discharging DRY waste heat?</p> <p>5.16 GW</p>	
FUTURE DRY-AC x 2	<p>What if the overall power of the current DRY waste heat was double?</p> <p>10.32 GW</p> <p>68% Central Paris 32% outside Offices</p>	

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